NRC NEWS

U.S. NUCLEAR REGULATORY COMMISSION

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No. S-01-026

ENHANCING THE NRC'S CAPACITY TO MEET NEW REGULATORY CHALLENGES

By

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Nuclear Safety Research Conference

Washington, DC
October 22, 2001

Introduction

Good morning. I am pleased to be able to address you today.

Although this is the 29th year that the NRC has held a conference on reactor safety research, I want to take special note of the change in the name of this conference. When I spoke at this meeting last year, I had no idea that I was addressing the final "Water Reactor Safety Information Meeting." Those of you who attended that meeting may recall that it was devoted in large part to a retrospective on the WASH-1400 report, which may, in hindsight, have been the perfect way to bring the era of the water reactor safety meeting to a close. I now have the pleasure of addressing the first "Nuclear Safety Research Conference."

The new name reflects the reality that the research carried out by the NRC, our contractors, our international partners, and the industry now extends beyond water-cooled reactors. The new name reflects an effort by the NRC to reach out to the broader nuclear community to explore new concepts and approaches in reactor design, fuels and materials, waste disposition, and related topics – in addition to addressing issues associated with the current generation of water-cooled reactors.

Nuclear Security

I would like to take a few minutes at the outset to reflect upon the events of September 11, and the impacts that those events have had on the NRC. Tomorrow marks six weeks since the United States was viciously attacked by terrorists. Although nuclear facilities were not targets, these brutal actions have brought home, in no uncertain terms, the potential threat that we face. When I say "we," I do not mean only the United States, but rather all those in the nuclear community, both in this country and internationally.

Let me say just a few words about the NRC response to the terrorist events. Shortly after the second attack on the World Trade Center, we fully staffed our Emergency Operations Center at headquarters and the counterpart offices in the Regions and put our major licensees on the highest level of alert -- a status we have maintained since September 11. We have no specific or general credible threat directed at an NRC licensee at his time, but the general threat environment is obviously very high. As a result, we have issued a variety of different threat advisories to our licensees, as well as guidance as to actions that our licensees should undertake to enhance security. We have engaged with the FAA, resulting in the issuance of a notice to airmen to avoid flyovers of nuclear power plants. We have also interacted with the military to assure that there is full awareness of the nature, and limits, of licensee capability to respond to attacks. We are working with the FBI and others in a variety of ways to assist in investigations and to assure the NRC's actions are coordinated with other agencies. And the NRC has communicated with the Governors of 40 states so as to assure that state assets -- state police or National Guard -- are available as needed.

The September 11th events have served as a wake-up call throughout the Government about the need to focus greater attention on the terrorist threat. With the full support of the Commission, I have directed the Executive Director for Operations to commence a top-to-bottom review of the NRC's safeguards and security system. This will encompass not only regulatory requirements, but also communications, the security of NRC facilities, and coordination with other agencies. Many of the important issues -- including in particular the definition of the boundary between those responsibilities that must be assumed by the private sector and those that must be undertaken by Government -- will require a broader societal discussion. These will not be issues for the NRC and its licensees to resolve alone.

I recognize as well that the effort does not stop at our borders. We must also depend on our friends and partners internationally to provide information on potential threats and to help find methods to deal with them. We must remember that a serious event or accident at a nuclear plant or facility anywhere in the world affects us all, and we must redouble our efforts bilaterally, multilaterally, and through organizations such as the IAEA and the NEA, to ensure the safety of nuclear facilities everywhere. I am hopeful that, with a dedicated focus by all, we can limit the threat that terrorism presents.

Let me now turn to the main topic of my speech -- enhancing the NRC's capacity to meet regulatory challenges.

NRC's Regulatory Challenges

Last year at this event I discussed the efforts of our Office of Nuclear Regulatory Research in the context of ongoing agency programs, especially those related to the economic deregulation of electricity. I focused on license renewal, power uprates, and the transition to a risk-informed approach to regulation. I then discussed anticipatory programs to prepare the NRC for new challenges, including innovative designs for new nuclear power plants.

In many respects, the situation today mirrors that which existed last year. I am pleased to say, however, that we are moving forward in meeting the technical and regulatory challenges. Our license renewal program is proceeding aggressively: three applications have been granted; seven plants, totaling 14 units, currently are under active review; and almost half the plants in the U.S. have indicated that they intend to pursue renewal. In fact, we expect that almost all of the plants in the U.S. will ultimately apply to have their licenses renewed.

We also expect to receive a large number of applications for power uprates of 10 percent or more, as licensees seek to maximize the economic contribution of their nuclear plants, while maintaining adequate margins to plant safety limits. Our responsibility, of course, is to ensure that such margins <u>are</u> maintained in order to protect public health and safety. New instrumentation and more realistic analytical techniques provide the means to justify power uprates without a compromise of safety margins.

We continue to make progress in risk-informing our regulations, although this has proven to be a slow and sometimes challenging process. And with regard to future reactors, we are proceeding with the "pre-application" reviews of new reactor designs, such as the AP1000 and the pebble-bed modular gas-cooled reactor, in anticipation of formal applications for design certification or a combined construction permit and operating license at some point in the future.

In these and many other areas, our research activities have made and continue to make significant contributions by providing the technical bases that comprise the foundation for our regulatory activities. The NRC's ability to continue over time to make such progress depends, however, on a fundamental underpinning -- what I shall call the "research infrastructure." There are three different components to this infrastructure -- technical personnel, experimental facilities, and analytical tools. Each of these components helps to provide the technical foundation for regulation. All are important because significant degradation of any of the components can seriously undermine that foundation. It is the maintenance of this infrastructure that is the focus of my remarks this morning.

<u>Personnel and Technical Skills</u>

Since becoming Chairman of the NRC, almost two years ago, I have come to regard the NRC staff as one of the most technically competent and highly skilled groups in the Federal government. Nonetheless, I must also acknowledge that the NRC is facing a potentially serious situation with respect to maintaining technical capabilities in the next few years. We have many times more people over the age of 60 than under the age of 30, and a significant fraction of the most experienced staff members are currently eligible to retire. Unless we can bring skilled new people on board and somehow transmit the accumulated knowledge of the veteran staffers to them, a great deal of the NRC's corporate memory may simply walk out the door. This problem of an aging workforce is not limited to the NRC; in fact, it extends across the nuclear industry, including utilities, vendors, and national laboratories.

We recognize the need to recruit young engineers and scientists and to ensure that they have the necessary technical skills and training. But, in doing so, we run into a second problem that is just as acute as that of our aging staff. Nuclear power has not been perceived as a thriving field by technically inclined students looking for professional challenges. As a consequence, the number of nuclear engineering programs in the U.S. has declined sharply over the last decade, and the enrollment in the ones that remain has fallen over the same period. This trend has been reported in several surveys, including the report of the blue-ribbon panel from the Nuclear Energy Research Advisory Committee.[1] This report, published in May of last year, indicates that while the decline in the number of programs and students began in the 1970s, the rate of shrinkage increased sharply in the early 1990s and has just recently begun to level off. Another report with a similar focus, published last year by the Nuclear Energy Agency of the OECD, indicates that these trends are international in scope.[2]

We are now seeing, at long last, a small but perceptible increase in student interest and enrollment. But it will take several years to get enough people into the pipeline to fill the need for nuclear engineers, especially if recent industry interest in the possibility of building new plants ultimately results in actual new orders. Needless to say, nuclear engineering is not the only technical discipline from which the NRC draws its staff, but the general reduction of interest in nuclear power as a career choice also has affected our ability to recruit mechanical, electrical, and chemical engineers, as well as those with training in other key scientific and engineering fields.

The shortfall in new nuclear engineering graduates creates a "double whammy" when it comes to recruiting for the NRC staff. The number of available candidates is very limited. But the fact that there are too few people to fill the entry-level slots across the industry tends to put upward pressure on starting salaries, and it is difficult for the NRC to compete with utilities, vendors, and other engineering firms. The NRC has recently undertaken an initiative to identify key technical needs in our staffing profile and to recruit aggressively to attract new staff members to fill those needs. We have revitalized our intern program, entry into which is based on academic achievement. Recent graduates are selected for an extensive training program that includes formal instruction and rotational assignments. When they have completed their training, the interns are then assigned permanently to key positions throughout the agency. We expect these people to be prominently represented among the next generation of leaders at the NRC.

Several management training programs are offered for more experienced staff, as well. For example, the NRC also sponsors a graduate fellowship program, through which staff members can obtain advanced degrees at the agency's expense. We are hopeful that the availability of these types of programs will make NRC more attractive as an employer. It is through these efforts that we strive to ensure ourselves of an adequate supply of highly competent staff to meet future challenges.

The themes of personnel demand and technical competence are closely linked, both in terms of attracting the brightest science and engineering students to study nuclear technology and in being able to transfer the experience and accumulated knowledge of veterans in the field to the new generation. It should come as no surprise, particularly to this audience, that strong, state-of-the-art research programs are seen as a key element in confronting this need. Let me then move on to address another of the aspects of "infrastructure" that I mentioned earlier: experimental facilities.

Experimental Facilities

The development of nuclear technology in general and nuclear power in particular is highly dependent on the use of experimental facilities in almost every discipline that contributes to the field.

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[1] M. L. Corradini, et al., "The Future of University Nuclear Engineering Programs and University Research and Training Reactors," commissioned by DOE's Office of Nuclear Energy, Science and Technology (May 2000).

[2] "Nuclear Education and Training: Cause for Concern?" OECD/NEA (June 2000).

Whether we consider reactor physics, thermal-hydraulics, the effects of radiation on materials, or fundamental knowledge in numerous other areas, the great wealth of information that is available to us today is built on the foundation of experimentation. In addition to their role in developing the technological base, research programs in general, and experimental programs in particular, also serve to attract bright young engineers and scientists into the field.

Some consider the period from about the early 1970s to the mid-1980s as a "golden age" of experimentation in the U.S., particularly with respect to reactor safety research. In the area of water reactor technology alone, for example, we had the benefit of facilities like SEMISCALE, LOFT, MIST, THTF, and FLECHT -- most of which were sponsored in full or in part by the NRC (or its predecessor, the AEC). These facilities provided the data to support accident assessments and the development of analytical models, some of which are still in use today. It is no coincidence that this was also the time when the number of nuclear engineering students was at its highest – even accounting for a slight drop right after the accident at Three Mile Island. When they graduated, many of those students were employed in the national laboratories that ran or used these facilities. Many of you in the audience probably were drawn to nuclear engineering and related disciplines in just this way.

Advances in nuclear safety research based on experimentation are, of course, not limited to the United States alone. Major facilities were built in France, Japan, and in many other countries. Much valuable water-reactor-related data have come from programs such as BETHSY at the CEA's Grenoble laboratory and ROSA at the Japan Atomic Energy Research Institute. In fact, confirmatory testing in the ROSA Large Scale Test Facility played an important role in the NRC's certification of the AP600 design.

Although experimental facilities have played a pivotal role in advancing nuclear technology, it is also true that they can be extremely expensive to build, maintain, and operate. As government and private support for nuclear research has fallen, particularly over the last decade in the U.S., we have seen many of our test facilities shut down and dismantled. Once such facilities are closed, it is virtually impossible to resurrect them and a valuable resource is gone.[3] Even more dismaying is the fact that the state of the art in data collection and retention has advanced so rapidly that the tapes and other media used to acquire and store the information gathered from previous test programs can, in some cases, no longer be read or are deteriorating to the point that the data are at risk of being irretrievably lost.

Another related resource that has suffered a similar fate in the U.S. has been non-power and testing reactors, particularly those at universities. This issue is also discussed in the report of NERAC's blue ribbon panel, to which I referred earlier. Just as the number of nuclear engineering programs and students has declined sharply over the past 10 years, we have seen a drastic decrease in the number of operating research reactors as well. This decline is a matter for concern for several reasons. University research reactors are often seen as an integral part of a successful nuclear engineering program and closure of the facility may be interpreted by students as a sign that the program is in trouble, which could serve to diminish enrollment further. Moreover, these reactors serve two important purposes. First, they help in the training of nuclear engineering students in aspects of reactor technology. And

[3]This issue is also a matter of international concern, and is the subject of another NEA report, developed by the Committee on the Safety of Nuclear Installations (CSNI) and released earlier this year. "Nuclear Safety Research in OECD Countries: Major Facilities and Programmes at Risk," OECD/NEA Committee on the Safety of Nuclear Installations (2001). The report addresses research facilities and programs that are in danger of being lost and ways in which these key resources can be maintained.

second, they provide important facilities for both basic and applied research, contributing to a wide range of projects from materials behavior to forensic investigation to the treatment of cancer. Many of our research reactors, both at universities and elsewhere, are quite old and are increasingly difficult and expensive to maintain. Their declining number is a source of real concern, particularly since no new facilities of this type have been built in the U.S. for many years.

Although much of the news from this sector of the nuclear technology community has been discouraging, I was recently pleased to learn that the University of Missouri-Columbia, home of the largest university research reactor in the U.S., has decided not to close its reactor. Rather, the university will create a Nuclear Science and Engineering Institute, of which the reactor will be the centerpiece. We can only hope that this positive sign will encourage other universities struggling with similar issues to keep their reactors operating as long as it is safe and practical to do so.

The loss of both in-reactor and out-of-reactor experimental facilities is a serious threat to the maintenance of our regulatory infrastructure. I have already alluded to the impact on attracting new, technically competent technical staff members to the field. Moreover, when important new research must be undertaken to address emerging technical issues, the facilities may not be available to respond quickly to the need. Thus, we may not have the necessary capability to develop and validate the third aspect of infrastructure: state-of-the-art analytical codes.

Let me turn to that subject now.

Analytical Tools

In the early developmental stages of nuclear reactor technology, much of the basic knowledge about how reactors work was gained by building small reactors, testing them, and observing what happened. As reactors got larger and more complex, it became clear that direct observation would have to be replaced by analysis, using mathematical models derived from experiments. For more than 30 years, researchers in government, industry, and academia have designed and operated experimental facilities that simulate reactors and their associated systems, structures, and components. Researchers have used these facilities to acquire data, to understand more fully the physical phenomena that are important to nuclear reactor safety, and to develop the analytical models that enable the accurate prediction of the behavior of the actual reactors and power plants.

The sophistication of these models has increased as computer technology, instrumentation, and data acquisition techniques have improved, and today we have literally dozens of codes and models to calculate thermal-hydraulics, neutronics and kinetics, fuel performance, severe accident phenomena, the behavior of materials and structures, and the dispersal of radioactive material in the environment, just to name a few. The art and science of designing experiments has grown more sophisticated as well, with formalized scaling methodologies such as the hierarchical, two-tiered scaling process, and techniques like the CSAU methodology for assessing the uncertainties associated with complex thermal-hydraulics codes.

Even analytical methodologies that are not directly associated with testing depend to a substantial degree on data from either testing or plant operations. For example, probabilistic safety assessment techniques rely on information on causes and rates of component and system failures as input to event and fault trees, and the establishment of success criteria for event sequences depends on accident analysis codes derived and validated using experimental results. Indeed, the NRC's evolution to a more risk-informed regulatory paradigm demands that our analytical tools be as realistic as possible, so that we can make sound, technically defensible judgments as to what is safety-significant and what is not.

The interrelationship between the different elements of the research infrastructure should be clear from this discussion. We need creative, well-trained people to design, operate, and analyze sophisticated, cutting-edge experiments that will help us develop the state-of-the art analytical tools to support critical regulatory initiatives, such as risk-informed regulation, safety reviews of advanced reactor designs, license renewal, and power uprates. Those creative, bright, and energetic engineers and scientists will be available to us only if we are able to establish experimental and analytical research programs that will attract them to nuclear engineering and associated fields as professionals.

Unfortunately, as I noted earlier, it is an undeniable fact that experimental facilities can be extremely expensive to design, build, operate, and maintain. With the NRC's research budget falling from more than $200 million in the mid-1980s to $40-to-50 million today – not accounting for inflation – it is clear that the NRC does not have the wherewithal to maintain the infrastructure by itself. We must look for other ways to tackle these critical issues.

Possible Approaches to Enhancing Infrastructure

In my view, the answer to the problem of maintaining and enhancing infrastructure is broad cooperation among all of the various sectors of the nuclear technology community. I realize that there are challenges to be faced in this regard, particularly with respect to cooperative work with the regulated industry, in view of conflict-of-interest concerns. Nonetheless, we have to find ways in which such obstacles can be successfully negotiated. The NRC's research program has been assessed many times by various groups: the National Academy of Science, the Advisory Committee on Reactor Safeguards, the former Nuclear Safety Research Review Committee, and most recently, a panel of experts drawn from across the community and chaired by former Commissioner Ken Rogers. In virtually every instance, the NRC has been advised to find ways to work cooperatively with the Department of Energy and the nuclear industry to provide adequate support for major research programs.

Cooperation does not necessarily refer solely to jointly funded research. For example, universities struggle to find adequate funds to operate their reactors and to upgrade them when necessary. DOE provides some funding for university reactor operations, and is looking at ways to do more. But the nuclear power industry – utilities, vendors, their contractors, and organizations like EPRI – should realize that they have a stake in keeping these facilities operating too. Research funding and outright grants should be available so as to ensure the continued viability of university reactors and nuclear engineering programs.

Cooperation extends beyond national borders, as well. International cooperation is a key element of enhancing the regulatory infrastructure, not only in the United States, but also everywhere that nuclear power is used. The international nuclear community already does much in the way of cooperative programs, through bilateral and multilateral programs and through organizations like the NEA and the IAEA. But we must do more. Various NEA reports contain many valuable suggestions in this respect, such as establishing international centers of excellence, exchanges of staff, and collaborating on defining core competencies and means for assuring that they are maintained. This does not mean that all countries will end up regulating nuclear power in the same way – I recognize that there may be many different paths to a successful outcome. But we should all strive to ensure that, whatever path we choose, our decision-making is informed by the best information that can be brought to bear from wherever in the world the information can be found.

Conclusion

My objective this morning has been to provide a vision of the direction in which I would like to see the NRC and the nuclear technology community move in order to ensure that our regulatory infrastructure is up to the task of establishing the technical bases for current and future challenges. I hope that you share this vision. I look forward to working together with you to reach our common goals.

Thank you.